

Papaahawahawa Bridge  
(Papahawahawa Gulch Bridge)  
Pi'ilani Highway spanning Papahawahawa Gulch  
Kipahulu, Hana District  
Maui County  
Hawaii

HAER No. HI-34

HAER  
HI  
5-KIPLU,  
1-

**PHOTOGRAPHS**

**WRITTEN HISTORICAL AND DESCRIPTIVE DATA**

Historic American Buildings Survey  
National Park Service  
Department of the Interior  
San Francisco, California

# HISTORIC AMERICAN ENGINEERING RECORD

## PAPAAHAWAHAWA BRIDGE (Papahawahawa Gulch Bridge)

HAER No. H1-34

Location: Papaahawahawa Bridge is located on the Pi'ilani Highway, 2.57 miles south of Hamoa Road, in Kīpahulu, Hāna District, Maui, Hawai'i. U.S.G.S. Kīpahulu Quadrangle, Hawai'i; 7.5 minute series, scale: 1:24,000. Universal Transverse Mercator (UTM) Coordinates: 04-2290640 - 811030

Present Owner: County of Maui, Department of Public Works and Waste Management.

Present Use: Highway bridge.

Significance: The Papaahawahawa Bridge is located within the proposed Hāna Highway Historic Bridge District (Spencer Mason Architects 1996). More than eighty bridges, or one every three-quarters of a mile, were constructed along the Hāna and Pi'ilani Highways between 1908 and 1940, providing overland access to the previously isolated Hāna district. The Papaahawahawa Bridge was constructed in 1913 and 1915 with Territorial funds and is an integral element of the belt road system in East Maui. The bridge is significant for its contribution to the fields of engineering and transportation in Hawai'i.

The bridges along the Hāna and Pi'ilani Highways aided the economic development of the island by linking the sugar plantations of Hāna with the rest of Maui. Sugar production changed the pattern of land ownership in the islands, created a viable trade-oriented economy and radically altered the demographics of the islands through the importation of wage-earning labor. The infrastructure required to support this massive economic endeavor - primarily for irrigation, transportation, and cultivation of sugar cane - changed the face of the islands forever. The bridges constructed along the east Maui belt road aided in the overland transport of raw cane to the mills for processing, as well as provided reliable access for workers to the sugar lands.

The Papaahawahawa Bridge is a product of the Territory of Hawai'i's Loan Fund program (ca. 1911-1915) and is representative of the progressive Territorial highway system in Hawai'i, as well as the County's public works efforts. The construction of reinforced-concrete bridges to replace earlier timber and metal bridges was a deliberate investment in permanent public works improvements requiring the mobilization of skilled labor and significant public funds.

Papaahawahawa Bridge, a concrete deck bridge, is a good example of early reinforced-concrete bridge construction in the Hawai'i. Concrete deck bridges, including flat slab and girder spans, are the most common County-built bridge type found in the islands. These bridges are also significant as early products of a new system of bridge design. The design work was done by professional engineers working for the County rather than being the responsibility of the bridge builder.

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## PART I. HISTORICAL INFORMATION

### A. Physical History:

1. Name:

The name "Papaahawahawa" is painted on both railcaps of the bridge. Hawaii's bridges are generally named for the feature that they cross; in this case, the Papahawahawa Gulch. Papahawahawa means "dirty flat" and is spelled with a second single "A", rather than the double "A" as appears on the bridge parapet, and all of the State and County records (Pukui et al., 1976).

2. Date of erection:

The bridge was built in two sections; the flat slab span was built in 1913, and the girder span was built in 1915.

The date "AD 1913" is incised in "mirror-image" on the outer side of the downstream parapet of the flat slab span. Newspaper was used as a slipsheet between the formwork and the concrete when the bridge was constructed. Remnants of the newsprint remain at the underside of the bridge; at least two news articles referring to the date "1913" are legible.

The 1915 date was identified the *Historic Bridge Inventory: Island of Maui* (Hawaii Heritage Center, 1990). This date most likely refers to the later girder span addition, and is confirmed by the *Bridge Inventory* (Bridge Data Sheets) prepared by the Territorial Highway Department in cooperation with the U.S. Department of Commerce, Bureau of Public Roads in 1951; and the *Structure Inventory and Appraisal Sheets for Bridges Built Before 1940* (computer printout known as the State Bridge Inventory) on file with the DOT Highways Division.

3. Architect/Engineer:

Unknown.

4. Original and subsequent owners and occupants:

Maui County.

5. Builder, contractor, suppliers:

Maui County Engineer's Office, according to the *Historic Bridge Inventory: Island of Maui* (Hawaii Heritage Center, 1990).

6. Original plans and construction:

No original drawings have been located for this structure. The original portion of the bridge appears to be the flat slab span located to the south (refer to the discussion under "date of erection" above). The lower portion of the masonry abutment and pier below the flat slab span appears to date from an even earlier bridge, which was constructed closer to the stream bed and followed the grade of the adjacent embankment.

7. Additions and alterations:

A reinforced-concrete deck girder structure was added (ca. 1915) to the north of the original flat slab bridge to accommodate the widening, or scouring, of the north bank of Papahawahawa Gulch.

B. Historical Context:

1. Design and Construction of Bridges and Roads in Hawai'i, Pre-History to 1941:

a. Background:

Hawai'i's socio-political history may be divided into four general divisions (1) Polynesian (Pre-western contact; 500 AD. to 1778); (2) European Discovery (1778 - 1810); (3) Hawaiian Monarchy (King Kamehameha 1810 to Queen Lili'uokalani 1893); and (4) Provisional Government - Republic of Hawai'i - Territorial Status - Statehood (1893 to present). Historic bridges remain from only the last period. Due to the intensive development experienced in the Hawaiian Islands in the post-war period, few stretches of roadway retain a significant concentration of earlier historic bridges; the Hāna Highway on Maui and the Old Māmalahoa Highway on the island of Hawai'i with their numerous spans remain exceptions.

Initially, road and bridge-building in Hawai'i developed in conjunction with the westernization of the islands in the early nineteenth century. Timber and stone were the prevailing bridge construction materials at this time. Stone was abundant in Hawai'i, but construction of stone bridges required skilled labor, which was scarce in the islands. Wood was the cheapest material, and many types (including native hardwoods and North Pacific Pine) were available. These pioneering bridges were unfortunately vulnerable to termite damage and floods. In an attempt to provide low-cost, permanent replacements for timber structures, steel truss bridges were imported from the United States by the Kingdom as early as 1884 (Alvarez 1987a: 29). For shorter spans, concrete slabs were the preferred solution, but at this date, concrete bridges that could achieve longer spans were beyond the available engineering and construction technology. Nonetheless, maintaining steel bridges proved too costly in Hawai'i's corrosive marine environment, and they were soon rejected for government roads (Alvarez 1987a: 39-40).

After the overthrow of the Hawaiian monarchy in 1893, the independent Republic of Hawai'i looked to the United States for annexation. Hawai'i became an American territory in 1898. During the Kingdom, road and bridge construction was undertaken by day laborers and prisoners. However, in 1896-97, contracts were let for a belt road on the Island of Hawai'i, the first time such a system was used extensively, resulting in the construction of hundreds of miles of roads on that island.

b. Bridge Construction During the Early Territorial Period (1898-1924):

The Hawaiian Islands were annexed by the United States in 1898. Seven years later, the Territorial Legislature established the county governments on the separate islands, granting them taxing and spending powers in their jurisdictions. Nonetheless, the counties still relied on legislative appropriations to supplement county funds for internal improvements, thus county road-building was closely tied to Territorial and Federal government largesse (Hawaii Heritage Center 1990: 5). Throughout much of the early twentieth century, the counties' road and bridge-building could not keep up with the islands' economic development and infrastructure needs.

In response to a chronic shortage of funds for belt road construction, the 1911 Legislature recommended the issuance of territorial bonds for belt road construction. A Loan Fund Commission, consisting of the Superintendent of Public Works, the County Chairman of the Board of Supervisors, and three county residents, was appointed to oversee the fund expenditures (Alvarez 1987a: 59). Each county had its own bridge design department

located within the County Engineer's office. Bridges along the belt roads were generally designed by the county engineers using Territorial Loan Funds. Many of the bridge engineers were technologically skilled and evidenced high aesthetic sensitivity. Most of Hawai'i's remaining historic bridges were constructed by the county governments using territorial funds.

The majority of bridges constructed with Loan Funds, including the Papaahawahawa Bridge, were short span reinforced-concrete deck girder or flat slab structures. In the first decade of the century, bridges were often as narrow as eight or nine feet; those on public roads averaged fourteen or sixteen feet. In 1911, The Loan Fund Commission established eighteen feet as its required road width, although sixteen feet was commonly used in rural areas. These specifications prevailed until the 1920s when they were expanded to twenty feet. Bridge railings were generally less than three feet high, and capped on top. More decorative concrete railings became common after 1919, occasionally rising to an artistic level with Italianate posts or Art Deco motifs.

c. Bridge Construction in Hawai'i after 1925:

Beginning in 1916, in anticipation of its entry into World War I, the U.S. Congress appropriated funds to assist states in developing their transportation networks (Alvarez 1987a: 67). Hawai'i, initially excluded from the federal aid system, received its first federal funds in 1925 and created the Territorial Highway Department (THD). Bridges were a special concern of the federal highway system, and the Territorial Highway Department began a systematic replacement of narrow and hazardous bridges. With ample funds, the THD began to straighten out the belt roads and build long, high bridges across the mouths of the valleys. Bridges constructed with federal aid dollars has longer spans and were more decorative than county financed bridges (Alvarez 1987a: 73). Reinforced-concrete tee-beam bridges dominate this period, although a few rare examples of open-spandrel concrete arches remain.

After the outbreak of World War II in December 1941, the military constructed many miles of roads in Hawai'i (Alvarez 1987a: 76). Civilian construction virtually halted as manpower and equipment were requisitioned by the military. In the post-war era, a sophisticated survey of the island's roads was completed by the Territorial Highway Department. This survey rated roads and bridges on a mathematical "sufficiency rating system" (Alvarez 1987a: 80). Fewer than half of the federal aid system's roads got a passing grade. The "Hawaii Statehood Transition Bill" of 1959 made available millions of federal dollars for highway improvement and development. The State Department of Transportation (DOT) was established in January 1960. Hawai'i continued to benefit from regular federal aid, such as the Highway Beautification Act of 1965 and aid for secondary roads. During the implementation of these federally sponsored projects, many earlier, historic bridges were demolished and replaced by modern constructions.

2. Hāna Highway, Maui; Pre-History To 1941:

The Hāna Highway winds around 617 curves and over fifty-six bridges in the thirty-five miles between the towns of Pā'ia and Hāna, and over another twenty-seven bridges in the ten miles beyond Hāna to Kīpahulu. The highway and its predecessor, the footpath built by the ancient Hawaiians, served as the link between Kahului, the island's principal town, and the isolated communities along the east Maui coast.

During his reign (ca. 1450 AD), Pi'ilani of the Lāhainā court unified Maui and created a network of unpaved roads extending throughout the island. One of these roads ran all the way from Wailuku to Hāna a distance of approximately sixty miles. Pi'ilani's son, Kiha'api'ilani, extended the road beyond Hāna, through Kaupō Gap, and across Haleakalā Crater (Weidig 1995: 1). This route to Hāna was well maintained for the next 250 years, and served as the only land link between the two ends of the island.

Around 1759, the king of the Big Island, Kalani'ōpu'u, captured Hāna and held it for more than twenty years. During this time, the road fell into disrepair and may have been purposely closed to thwart incursions from the north. Nonetheless, in about 1780, Kahekili, the king of north Maui, retook Hāna and reopened the road, which by then needed extensive repairs. The road was cleared and wooden bridges were built to replace the old, treacherous staircases painstakingly carved into the cliffs in prior centuries. Nonetheless, the road could support no more than foot traffic; it served that capacity until 1900, by which time Hāna had become a thriving sugar plantation community.

In 1848, King Kamehameha III declared the *Mahele*, which released one third of all Hawaiian lands to the common people, and allowed foreigners to own private property in the islands for the first time. Among them was George Wilfong, a *haole* (Caucasian) sea captain, who capitalized on the needs of the 1849 California gold rush miners by planting sixty acres of sugar cane in Hāna. The sugar was transported by ship from Hāna Bay, and despite the successful business, there was no substantial overland trading between the north and south parts of Maui.

In 1877, fifteen miles of unpaved road was constructed from central Maui to Kailua in order to build the Ha'ikū Ditch, a remarkable engineering feat that watered new cane land on the central Maui plateau (Lueras 1983: 17). In 1899, the Nāhiku Rubber Company planted thousands of rubber trees on the *makai* (toward the ocean) side of the old road. This enterprise pushed the unpaved road another fifteen miles to Nāhiku. East Maui's potential tourism value gave the county an incentive to promote a belt highway to Hāna. As early as 1900 the *Maui News* editorialized in favor of a good wagon road connecting Hāna and central Maui. This prompted the building of the first stretch of improved roadway, which followed the old unpaved road from Ke'anae to Nāhiku. The ancient footpath was widened to sixteen feet, to accommodate horse-drawn wagons, and was surfaced with cinders. The 1905 Superintendent of Public Works report stated that "very rough country is encountered in these districts. On account of the great expenses of road construction, the road has been made as narrow as possible in order to construct, with the money available, the maximum length of road" (Territory of Hawai'i, DPW 1905).

The new road segment functioned so well that there were soon calls to extend it from Kailua all the way to Kīpahulu, well past Hāna. In 1903, the Territorial legislature refused to fund the project. Undaunted, commercial entrepreneurs from Pā'ia to Hāna lobbied the legislature heavily, resulting in the improvement of another stretch from Kailua to Ke'anae, in 1904. This stretch met significant construction problems, including jungle encroachment, torrential streams and landslides, all of which doubled the original \$50,000 cost.

Between 1905 and 1908, the county built a series of reinforced-concrete bridges near Nāhiku. Bridge building on Maui surged in 1911, when the Territorial Legislature established a Loan Fund Commission to oversee a special fund for belt roads. Out of the \$1,270,000 appropriated by the Commission in 1911, Maui received \$370,000. This made possible the building of twenty-one Maui bridges: four on the Hāna Belt Road, four on the Pi'ilani Highway south of Hāna, six in the upcountry district, six in Central Maui

and one in West Maui (Hawaii Heritage Center 1990: 5). Work on the belt road continued depending on the extent of funding. By 1912, a narrow road and several bridges, adequate for automobile traffic, were built between Kailua to Ke'anae utilizing territorial funds. Contractors Wilson and McCandless had completed the Nāhiku-Ke'anae section of road by 1915. This road did not link up with the Kailua extension, but instead dead-ended in the Ko'olau Forest Reserve. The lack of a continuous paved road prompted one Maui legislator to complain that "Maui is the only island on which you cannot traverse by road around it" (*Maui News*, 11 Feb 1921: 1).

Until this time, the journey to Hāna was made partly over unpaved wagon roads and horse trails, often rendered impassable by damage from frequent rains. An alternative route through the island's south side took the traveler through the drier ranch country ending at Kīpahulu. Since both land routes were arduous and slow, the most common means of travel to Hāna was by steamer ship. Writer Robert Wenkam states that:

When Hana was without a road, and the coastal steamer arrived on a weekly schedule, Hana-bound travelers unwilling to wait for the boat drove their car to the road's end at Kailua, rode horseback to Kaumahina ridge, then walked down the switchback into Honomanu Valley. Friends carried them on flatbed *taro* trucks across the Keanae peninsula to Wailua cove. By outrigger canoe it was a short ride beyond Wailua to Nahiku landing where they could borrow a car for the rest of the involved trip to Hana. Sometimes the itinerary could be completed in a day. Bad weather could make it last a week (Wenkam 1970: 65-66).

Inspired by the dramatic expansion of the sugar industry at Hāna, the Maui County Board of Supervisors pressed the Territorial legislature for funding to improve the rest of the old road as far as Kīpahulu, and entertained a vision of a Belt Road that would eventually circle the entire island. Territorial Governor Lucius Pinkham was adamantly opposed to the project, consequently it took until 1923 until belt road planning was resurrected and modifications to the ancient route were given serious consideration.

Despite its prohibitive cost, the county eventually decided to complete the paved road to Hāna. In May 1923, a total of \$50,000 was appropriated from the Territorial Legislature for road work, although twenty years earlier an equal amount proved inadequate for a shorter length of road, and that an additional \$200,000 had been needed to overcome similar construction difficulties. The more heavily traveled sections, from Ke'anae to Pā'ia, were at least partially paved by 1926, but farther south the road remained unpaved. The worst of the construction problems lay ahead, between Kailua and Kōpili'ula Falls (Weidig 1995: 2). In July 1926, a massive landslide covering more than thirty acres halted further work. Floods during the winter of 1926-27 washed out embankments constructed not two months earlier. Overruns associated with the already constructed portions left the Territorial legislature in no position to continue funding the road. Despite these obstacles, Federal Aid funds, which were made available to Hawai'i in 1925, provided the necessary relief, and the project pushed its way toward Hāna. To lower costs, the county administration established a prison camp at Ke'anae, and pressed the hardest criminals into road gangs that eventually turned the remaining barely passable trails leading to Hāna into a cinder-paved highway that could handle trucks and cars.

Keeping the road maintained and open, especially along the unstable area between Nāhiku and Ka'elekū, was a major undertaking. The Territory, and later the State, hired numerous residents in and around Hāna as seasonal workers dedicated to repairing the damage wrought by mud slides, rockfalls, downed trees and erosive floods. The early

wood bridges were continually washed out, eventually to be replaced by the present-day reinforced concrete bridges. A boost for the roadway came in 1934, with the creation of the Hāna Coast Civilian Conservation Corps, one of Franklin D. Roosevelt's job programs designed to combat the effects of the Great Depression. By 1940, the highway was substantially complete. In 1946, the Hāna Ranch developed the first hotel in Hāna for tourists who made the journey to this previously isolated community by road.

A journalist driving through the ditch country at the time called the Hāna Belt Road a "paved trail following the line of the ditch through the wild jungle" (*Honolulu Advertiser*, 27 Apr 1940: 3). It wasn't until 1962 that the newly-created Department of Transportation took responsibility for the maintenance of the road. More than \$2 million was allocated for widening, paving and restoring the highway from beginning to end. When the job was finished in 1964, the "highway" was at last negotiable by even the heaviest vehicles, at least in good weather. Residents have resisted further upgrading of the roadway since improvements would "result in a tidal wave of visitors and would destroy the fragile balance between being fed by tourism and being consumed by it" (Lueras 1983: 81). Since 1985, a well-planned maintenance program has preserved the road as one of Hawaii's most scenic and treasured drives.

### 3. Papaahawahawa Bridge in the Context of Historic Property Types:

The most prevalent construction material for Hawai'i's historic bridges is reinforced-concrete since the corrosive nature of the salt air from the Pacific Ocean and the presence of destructive insects makes the maintenance of steel and wooden bridges less practical here than in the mainland United States. Concrete construction technology rapidly advanced in the early decades of the twentieth-century. Stone, sand, gravel, and lime were found in abundance in the islands; however, reinforcing steel was generally imported from the U.S. mainland.

Simple reinforced-concrete slab bridges were an alternative to metal or timber stringer structures. Concrete flat slab bridges were constructed in Hawai'i from 1908, when the oldest remaining example was built, until approximately 1937 when moment-resisting concrete rigid-frame bridges became common. Early flat slab bridges often consisted of new simple concrete decks built over the original nineteenth century stone abutments. The slabs were cast on site, with formwork built by local carpenters. The appearance of these bridges was augmented by a variety of railings, ranging from solid parapets to open balustrades. The earliest remaining examples in Hawai'i include the 1908 Mokulehua Bridge, the 1910 Pua'alu'u Stream Bridge, and the 1911 Waikamoi Stream Bridge, all located on the Hāna Highway. Two flat slab bridges of similar age and construction to the 1913 Papaahawahawa Bridge- the Wai'oli and Waipā Bridges, built in Hanalei, Kaua'i in 1912 - were determined to be eligible for the National Register of Historic Places in 1978.

The first flat slab span of the Papaahawahawa Bridge was constructed in 1913. The bridge was extended by the County Engineer's Office in 1915. This addition utilized concrete girders to accommodate the twenty-two foot span. As the strength and economy of deck girder bridges became apparent, they replaced concrete and masonry arches for short spans (Alvarez 1983: 73). Many of these inexpensive bridges were built by the county governments around 1911-12 and numerous examples remain along the Hāna Highway. Like flat slab bridges, early concrete girder bridges tend toward solid paneled reinforced-concrete parapets and peaked concrete rail caps, and little or no ornamentation.



## PART II. ARCHITECTURAL INFORMATION

### A. General Statement:

1. Construction type:  
Two span, reinforced-concrete flat slab and deck girder bridge.
2. Condition of fabric:  
The overall condition of the bridge is fair. The construction of the second (girder) span is cruder than that of the original flat slab bridge. This additional span appears to have been built in haste, utilizing large diameter rough aggregate and poorly compacted concrete. The concrete is now spalling and the steel reinforcing bars are exposed and rusted in sections, particularly at the underside of the structure.

### B. Description:

1. Overall Dimensions:

number of spans:	two (one 11-foot flat slab span and one 22-foot girder span)
total length of roadway:	40.3 feet
max. span(s):	22 feet
roadway width:	14.5 feet
height above stream:	9 feet
2. Substructure:

The original flat slab span has an unreinforced masonry (basalt or "lava-rock") abutment and pier. The lower portion of these appear to date from an earlier bridge, which was constructed closer to the stream bed and followed the grade of the adjacent embankment. The girder span utilizes reinforced-concrete piers and abutments. The wingwalls on the upstream side of the bridge are constructed from lava-rock.

The pattern of the twelve-inch wide wood boards used to form the concrete remain evident at the underside of both bridge spans.
3. Superstructure:

The bridge was constructed in two segments to accommodate the widening, or scouring, of the north bank of Papahawahawa Gulch. The earlier section, to the south, is a single-span reinforced-concrete flat slab; a later addition, to the north, is a single-span reinforced-concrete deck girder structure.
4. Floor/decking:

Asphalt on a reinforced-concrete deck.
5. Parapets:

Solid reinforced-concrete parapets, two feet high, with rectangular concrete rail cap.
6. Other features:

The mirror-image of the words "AD 1913" is incised on the exterior of the downstream parapet of the original flat slab span.

C. Site:

The bridge sits on a rectangular shaped parcel measuring 40.3 feet by 15.8 feet, which is centered on the UTM point 04 - 2290640 - 811030. Included within this parcel are the bridge's superstructure, substructure, floor system, and approach spans.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

No original drawings were located for this bridge. The earliest sketch of the structure was included in the *Territorial Bridge Inventory* (Bridge Data Sheets) prepared by the Territorial Highway Department in 1951. The bridge was later recorded in the County of Maui Department of Public Work's *Inventory of Bridges*, prepared by Wilson Okamoto and Associates in 1980. The bridge appears unchanged from this time.

B. Early Views:

No early views of this structure were located.

C. Bibliography:

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#### PART IV. PROJECT INFORMATION

The Maui County Department of Public Works and Waste Management has developed plans to replace the Papaahawahawa Bridge with a new structure designed to meet current engineering and roadway safety standards. Bids for the construction of the new bridge, which include the demolition of the Papaahawahawa Bridge, are to be let by the County in April 1997. The project triggered Section 106 of the National Historic Preservation Act of 1996 (as amended), since the work will be undertaken using Federal Highway Administration funds and a Nationwide Permit for Road Crossing was required from the U.S. Army Corps of Engineers for dredge and fill activity under the Federal Clean Water Act. In a letter dated May 7, 1996, the Hawaii State Historic Preservation Officer made a determination of "no adverse effect" pending the completion of three mitigating elements, including design review of the proposed new bridge, photo documentation of the existing Papaahawahawa Bridge in accordance with HABS/HAER standards, and the development of a preservation plan for the bridges along the Hana Highway prior to the replacement of any Maui County bridge in the Hana District. This HAER report was prepared in partial fulfillment of these requirements.

This project was undertaken in October 1996 by Spencer Mason Architects, Inc., as a subcontractor to Wilson Okamoto and Associates, Inc., of Honolulu, Hawai'i. The historic architect for the project was Barbara Shideler, AIA of Spencer Mason Architects, who undertook the field investigations, 35 mm photography, research, and report writing. Laura Mau of Wilson Okamoto and Associates provided a copy of Maui County Department of Public Work's *Inventory of Bridges: Papaahawahawa Bridge.* The large-format photographs were produced in accordance with HABS/HAER standards by David Franzen of Franzen Photography.

Figure 1. Location and site map.

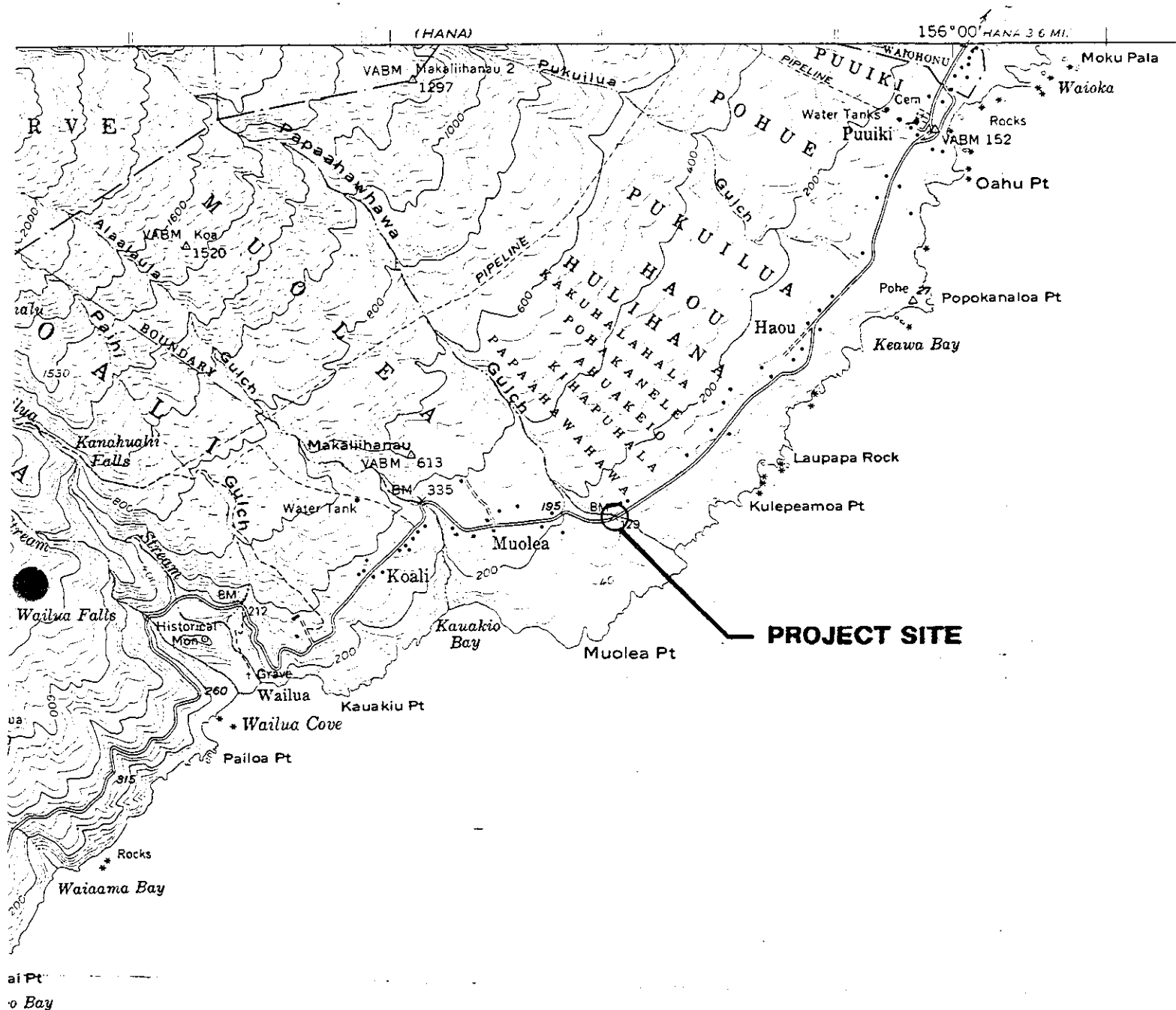


Figure 2. Plan.

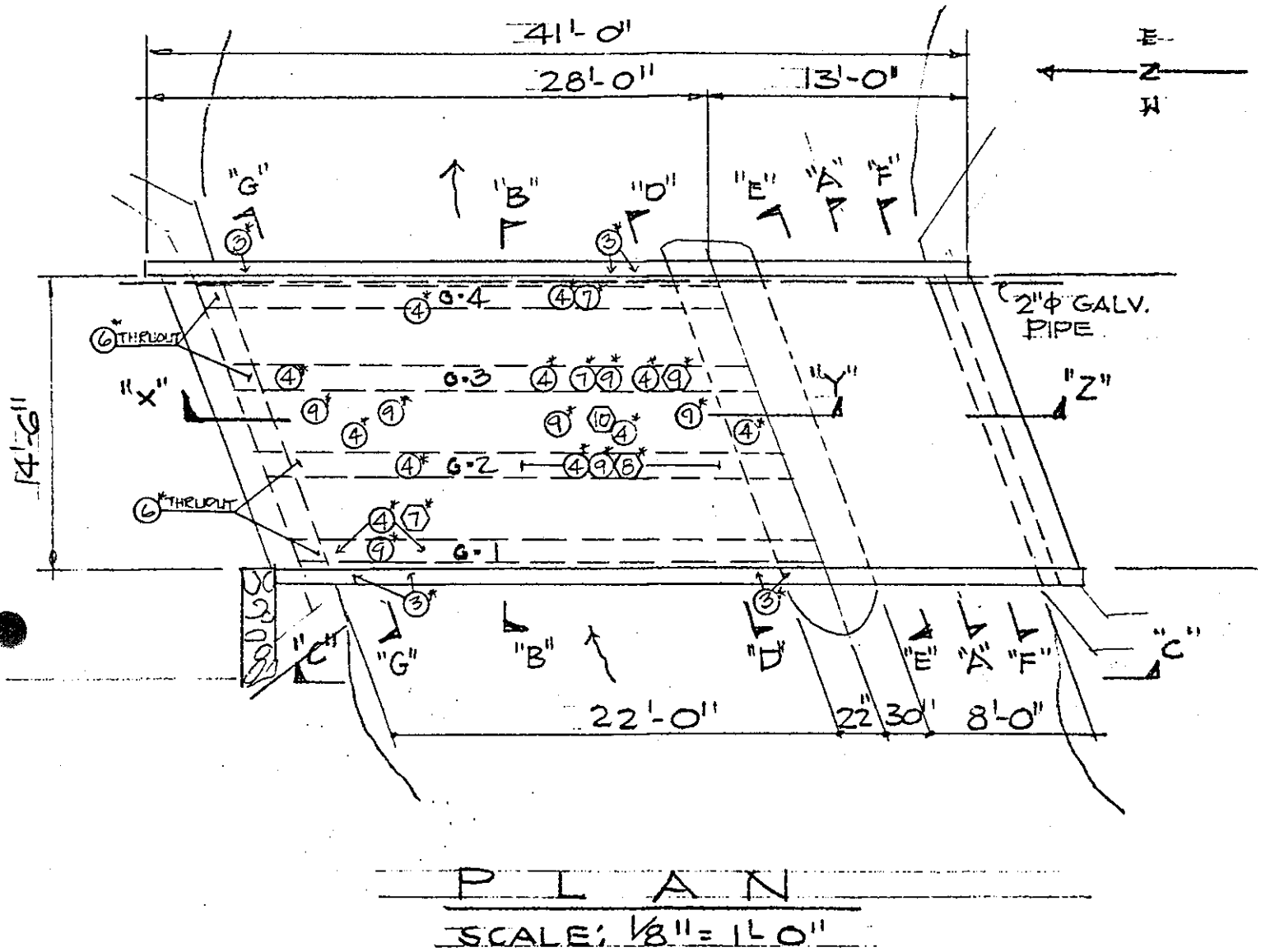
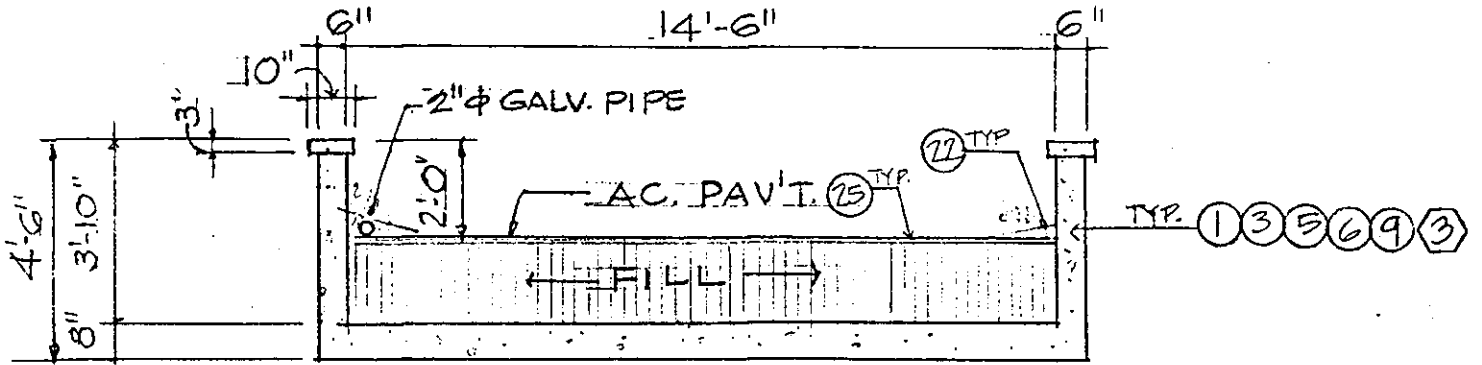
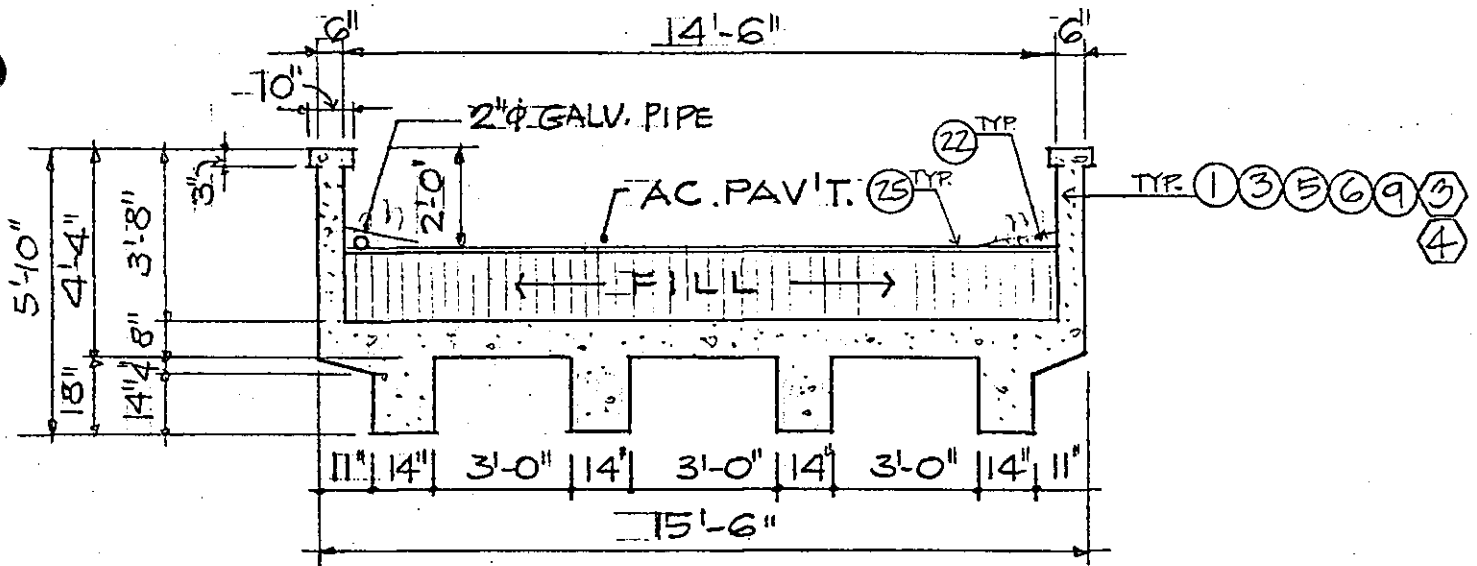


Figure 3. Cross-sections.



SOUTH BRIDGE CROSS-SECTION "A-A"

SCALE: 1/4" = 1'-0"



NORTH BRIDGE CROSS-SECTION "B-B"

SCALE: 1/4" = 1'-0"

Figure 4. Elevation and pier sections.

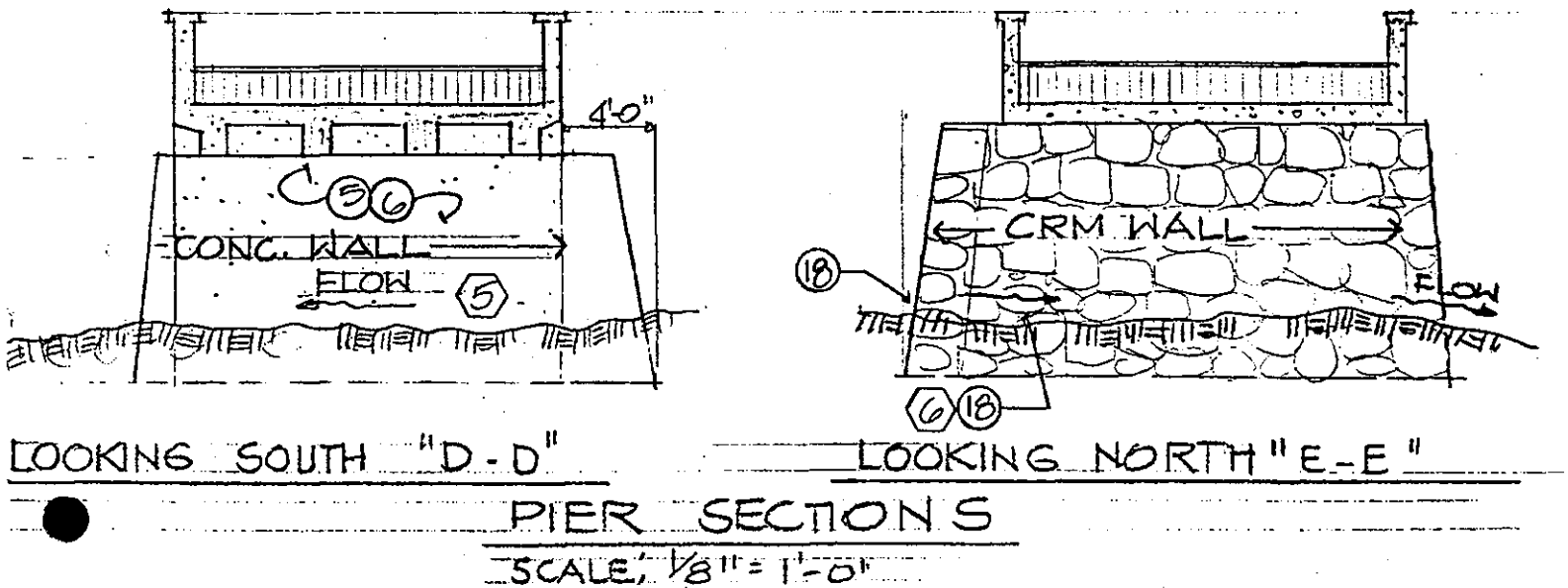
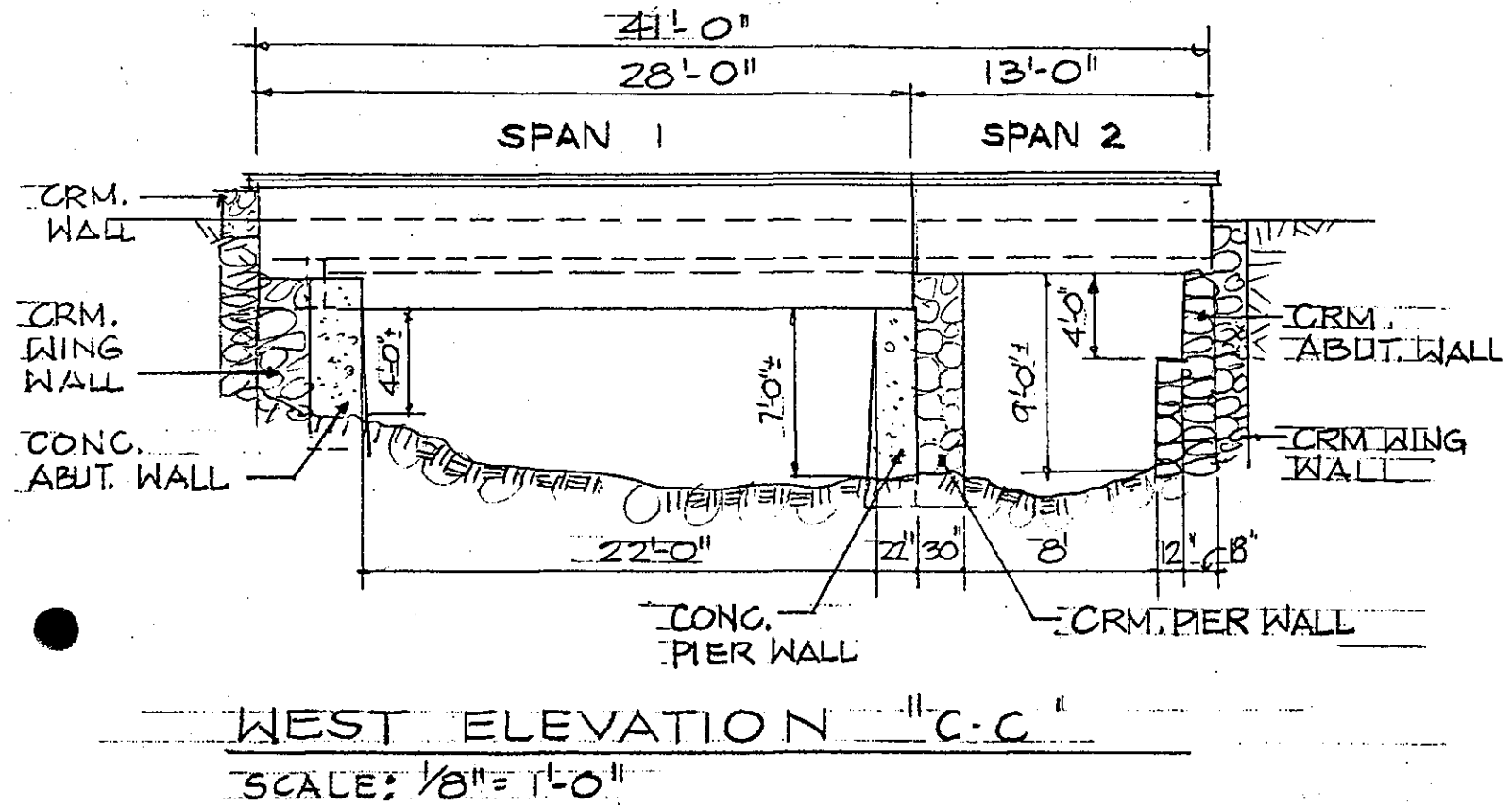
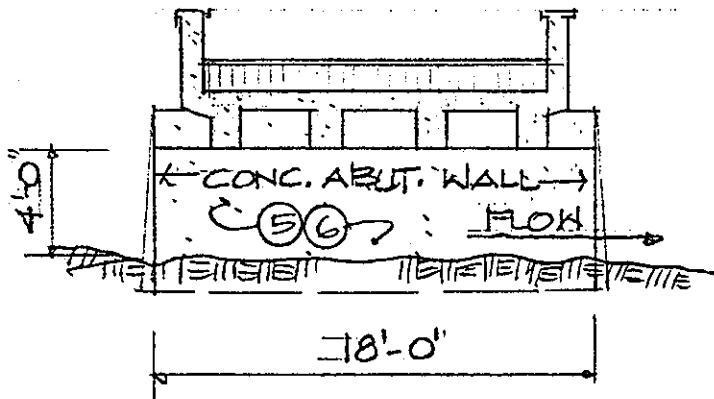
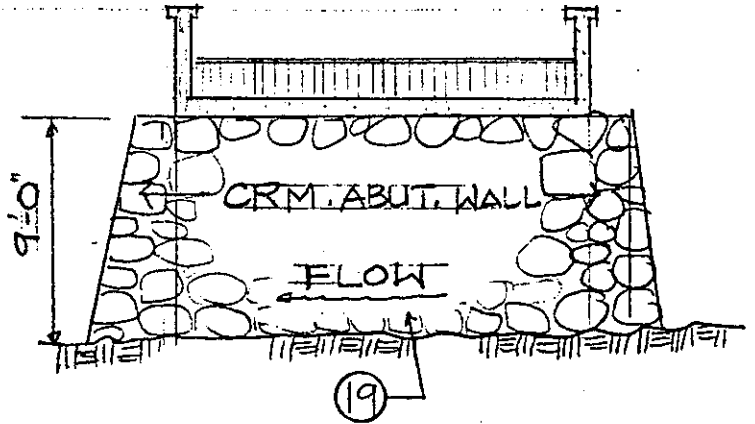


Figure 5. Abutment and pier details.



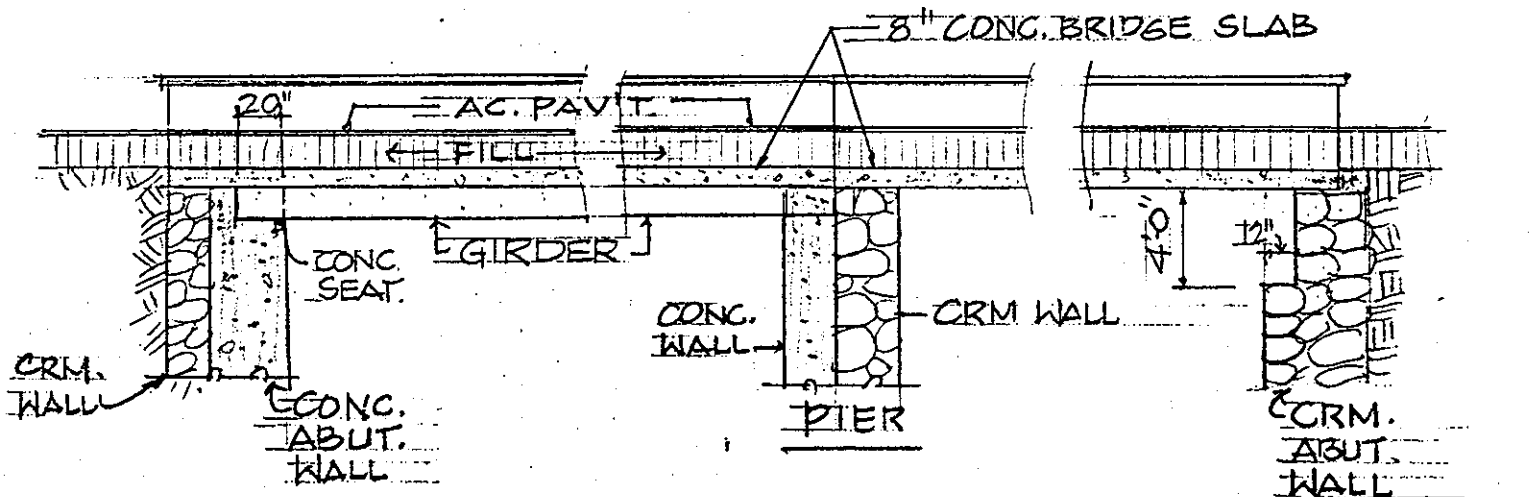
NORTH ABUT. SECTION "G-G"

SCALE:  $\frac{1}{8}" = 1'-0"$



SOUTH ABUT. SECTION "F-F"

SCALE:  $\frac{1}{8}" = 1'-0"$



NORTH ABUT. "X"

PIER "Y"

SOUTH ABUT. "Z"

ABUTMENT & PIER DETAILS "H-H"

SCALE:  $\frac{1}{8}" = 1'-0"$